

Bite Marks Analysis: An Insight in Human Identification

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Abstract

The first scientific report on bite mark analysis is published by Sorup. He coined the term "odontoscopy" for bite mark identification analogous to the fingerprint identification called dactyloscopy. The exact identification of a living person using individual traits and characteristics of the teeth and jaws is the basis of bite mark analysis in forensic odontology. The bite marks left on a person may be used to identify the suspects. Bite mark identification is based on the individuality of a dentition which is used to match a bite mark to a suspected person. One can exactly match the bite marks to the accused biter's dentition. The forensic odontologist should be quite careful while giving opinion regarding the origin of the bite mark and the identification of the criminal on the basis of bite mark evidence. The conviction whether the accused is the biter or not is based on the expert testimony of the forensic odontologist after matching a bite mark with that of the dentition of the accused.

Keywords: Bite Mark Analysis; Bite Mark; Criminal Bite; Forensic Odontology.

Introduction

Forensic odontology is a legal branch of dentistry which is concerned with dental evidence investigation, proper handling, precise evaluation and presentation of dental findings in the interest of justice. It also involves the application of dental knowledge to those criminal and civil laws that are enforced by police agencies in a criminal justice system [1]. The forensic odontology has wide acceptance in the field of criminal justice system due to inter-individual variation in teeth i.e no two individuals can have identical teeth [2]. A bite mark is a mark created by teeth either alone or in the combination with other oral structures [3]. Sorup was the first to publish a scientific analysis of bite marks [4]. Bite marks can be found in food items, utensils, cigars, pipes and musical instruments [5]. The bite marks on the body of humans can result from a number of causes such as sexual violence including sexual homicide, rape and child sex abuse. The bite

marks in sexual violence are found clustered around the genitalia and surrounding structures. Females are usually bitten on the breasts, nipples, abdomen, thighs, buttocks and pubis while men are usually bitten on the back, arms, shoulders, chest and penis. In cases of homosexuals and lesbians bite-marks are generally found on the back of the shoulder, arm or armpit, chest, penis or vagina. In cases of self-defense the victim can bite on the hands and arms of an assailant [6]. The bite mark evaluation of suspect's dentition is done by comparative method which includes analysis and measurement of size, shape and position of the individual teeth [7]. Most comparative methods involve the fabrication of overlays [8] by various methods like hand tracing from dental study casts, hand-tracing from wax impressions, hand-tracing from xerographic images [9] the radiopaque wax impression method [10] and the computer-based methods. The forensic discipline is concerned with the application of science and technology to the detection and investigation of crime and administration of justice by multidisciplinary approach [4]. A forensic odontologist is involved in the comparative analysis of bite marks on victims and suspect's teeth and presentation of bite mark as evidence in court as an expert witness. As two fingerprints are never alike, neither are the two bite-

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marks [11]. The standard techniques for examining bite marks are based upon interpreting photographic evidence in which a bite is compared with the models of the teeth of suspects [12]. So bite marks are considered as valuable alternative to fingerprinting and DNA identification in forensic identification.

Classification of Bite Marks

Bite marks can be broadly classified as animal bite marks and human bite. Based on the manner of causation, the bite marks can be non-criminal as well as criminal. The criminal bite mark further classified into offensive (upon victim by assailant) type and defensive (upon assailant by victim) bite marks [13]. Broadly bite marks are classified in seven types [14]-

- Hemorrhage type (a small bleeding spot)
- Abrasion type (undamaging mark on skin)
- Contusion type (ruptured blood vessels, bruise)
- Laceration type (near puncture of skin)
- Incision type (neat punctured or torn skin)
- Avulsion type (removal of skin), and
- Artifact type (bitten off piece of body).

These are further classified into four degrees of impressions a. Clearly defined type that results from the application of significant pressure, b. Obviously defined type which is the effect of first degree pressure, c. Quite noticeable type due to violent pressure and Lacerated type when the skin is violently torn from the body [7]. The following classes that are of proven significance in practical application regarding bite marks are: Class I: It includes diffused bite marks which is having limited class characteristics and lacks individual characteristics. Such as bruise, diffused bite mark, a smoking ring or a faint bite mark. Class II: This pattern of injury referred as a single arch bite or the partial bite mark as it has some individual and some class characteristics, Class III: This classification includes both individual as well as class characteristics. This bite has great evidentiary value and used mostly for the comparison purposes. The main sites for this type of bite on the body are buttocks, shoulder, an upper arm or the chest. The pressure and deep penetration of tissue is held to record the lingual surface of anterior teeth. Class IV: Mainly avulsion or laceration of the tissues is caused by the bite. In this class, class characteristics and individual characteristics are not present. This type of bite is commonly found where there is avulsion of an ear or finger [15].

Individual Characteristics of Bite Marks

Individual characteristics are deviations from standard class characteristics. They are the specific features found within the class characteristics which can be a feature, trait or a pattern that represents an individual variation rather than an expected finding. Arch characteristics and dental characteristics are the two types of individual characteristics. The arch characteristics help to differentiate between individuals by distinguishing one person's arch from another. It is based on the fact that some patterns, features or traits may be seen in some individuals and not in others. Dental characteristic is specific to an individual tooth and makes one tooth different from the other tooth. Eruption is continuous process and the teeth are subjected to various changes like sports injuries, chemical injuries, biologic attacks, motor vehicle accidents, workplace accidents and dental caries. After such damages have taken place, the teeth are in need of restoration. These restorations or the injury itself produces distinctive and unique features within a tooth. Each human dentition is unique [16]. The teeth of different individuals differ from one another with respect to their size, position and shape in the dental arches. These differences may be produced by various physical and chemical injuries affecting the teeth over the years like attrition, abrasion, erosion [17]. The eruption sequence of maxillary and mandibular anterior and posterior teeth also provides uniqueness to the human dentition. The erupting canine forces its way into the dental arch which causes displacement, rotation and may even cause bodily movement of the surrounding teeth. This uniqueness of the human dentition produces a pattern which can be compared the patterns which are found on the skin or other objects which have been bitten [16]. An ideal human bite mark is doughnut shaped which consists of two U shaped arches representing the mandibular and the maxillary arches separated from one another at their base. The individual arches are produced by the anterior six teeth [18]. When teeth in only one of the two arches contact the skin during biting then instead of the two U shaped marks, only one C shaped mark is produced by biting. Such types of bite mark patterns provide very less information to the investigator. The diameter of the bite mark injury usually varies between 25-40 mm in diameter. The size of an injury must fall within the known parameters of the human dentition, from a pediatric dentition through mixed dentition to complete adult dentition [18]. In the centre of the bite mark injury, there is extra vascular bleeding causing bruising in skin due to the pressure created by the biting teeth and by the negative pressure created by

tongue and suction. The color of these bruising changes over a period of time due to healing process of skin.

Anatomy of the Typical Human Bite Mark on Skin

Adult human dentition consists of 32 teeth, each of which varies in its size, shape and function. The full complement of teeth comprises two incisors, one canine, two premolars and three molars in each upper and lower quadrant. The characteristic oval-pattern injury that results from the action of biting will typically reveal several of the anterior teeth in each arch particularly canines and the incisors. A very frequent observation noted during bite mark investigation is that the mandibular anterior teeth are exhibited more clearly than the maxillary teeth. Bite mark dynamics can be influenced by many factors. There can be variations that occur during bite infliction with both the perpetrator and victim influencing the resulting injury in a contrasting manner. Furthermore variations can also occur during the recording and preservation of the evidence in addition to any external or environmental influences [19].

Mechanism of Bite Marks

A bite mark occurs mainly due to pressure of teeth on skin. It is accompanied by mandibular closure and suction of skin. Upper jaw is usually stationary and holds and stretches the skin and lower jaw is moveable and gives the most biting force. A human bite mark is an elliptical or circular injury with specific characteristics of the teeth. If there is a single "C" shaped mark, then only one jaw is involved. The diameter of injury ranges from 25-40 mm bruising within the marks is caused by pressure from the teeth as they compress the tissue inward [16].

Bite Mark Analysis

Any bite mark analysis involves two steps, first the discovery and preservation of evidence and second step involves evaluation, comparison and findings of the recovered evidence. The first step in analyzing bite-marks is determination that the injury is a bite-mark or it is caused by human teeth. The consistency of bite marks with the time of the crime should be determined.

To standardize the analysis of bite marks the American Board of Forensic Odontology has established the following guidelines in 1986-

- History: Thorough history of any dental treatment carried out after the suspected date of the bite

mark should be taken.

- Photography: Extra oral photographs including full face and profile views, intraoral should include frontal views, two lateral views and an occlusal view of each arch, a photograph of maximal mouth opening.
- Extra-oral Examination: Soft tissue and hard tissue factors that may influence biting dynamics. Measurements of maximal opening and any deviations on opening or closing should be noted.
- Intraoral Examination: Examination of tongue and periodontal status like mobility of teeth. In case of recent marks, they should be swabbed for DNA from saliva left in the wound.
- Impressions: Two impressions of each arch using materials that meet the American Dental Association specifications should be taken and occlusal relationship should be recorded.
- Sample Bites: Sample of suspects bite in centric occlusion using wafer of base plate wax or silicone putty material. The sample is photographed immediately and used for future comparison 7) Study Casts are prepared using type II stone [20].

Collection of Evidence from the Victim

The collection of evidence associated with the bite mark is very important and crucial to investigate the injury. Healing of the bite mark occurs in a living victim and degradation occurs in a deceased victim. Therefore it is important to review and document the injury pattern over time [18].

Saliva swabs of the bite site [18]- About 0.3 ml of saliva is deposited while making a bite and saliva is one of the various body fluids from which DNA can be extracted. In bite injury cases when the offender's mouth comes in contact with the victim's skin, there is deposition of offender's saliva on to the skin of the victim. This can be used as a source of salivary DNA for investigational purposes to solve criminal cases.

Photographing the Bite Mark

This is an important step during investigation as the photograph of bite-mark should be accurately produced. The use of digital camera instead of traditional allows the odontologist to reduce the margin of error. A life size dimension of the photograph is then recreated. If much time has lapsed after the mark was made then alternative photographic methods using ultraviolet light can be used to make images of the tips of the penetrated area [21].

Bite Mark Analysis and Identification

The exact identification of a living person using individual traits and characteristics of the teeth and jaws is the basis of forensic odontology [22]. The bite marks left on a person may be used to identify the suspect. Bite mark identification is based on the individuality of a dentition which is used to match a bite mark to a suspected person. One can exactly match the bite marks to the accused biter's dentition [23]. The first scientific report on bite mark analysis is produced by Sorup. He coined the term "odontoscopy" for bite mark identification analogous to the fingerprint identification called "dactyloscopy. In odontoscopy the plaster casts of the teeth of the suspect are obtained, dried, and varnished after which the incisal edges and occlusal surfaces are coated with printer's ink. Upon this inked surface a sheet of moistened paper is pressed and a print is transferred from it to transparent paper. This print is placed over a life-size photograph of the bite-mark and compared. The most important step in bite mark analysis is to recognize a patterned injury as a human bite mark followed by pattern analysis of the bite mark which provide the individual information about the suspect or an offender and relate the person who is involved in the crime. Bite marks with high evidence value that can be used in comparisons with the suspects' teeth will include marks from specific teeth that record different characters. The surface abrasion or subsurface haemorrhage caused by human bites appears as an arch. They are caused by the incisors, canines and premolars. Contusions are the most common type of bite mark. It can be determined from the type of bleeding under the skin whether the victim was alive or dead at the time the bite mark was delivered [18]. It is important to have individual characteristics in the bite mark to identify the suspect. Use, misuse, and abuse of the teeth result in features that are referred to as accidental or individual traits. If individual traits are not present in the teeth in the bite marks, the forensic significance of the bite mark is reduced [18]. Sometimes palatal rugae impressions obtained along with the impressions of teeth can also help in the identification of the individual involved in crime. These are present in the form of a crest and are usually three to seven in number [12]. One of the most remarkable, difficult and sometimes troublesome challenges in forensic dentistry is the identification, recovery and analysis of the bite marks with the suspected biters. In a recent communication, Pretty and Sweet [16] described the current status and a paradigm shift in the analysis of bite marks following some recent research and case studies of wrongful convictions on the basis of bite marks. They further stressed that though the bite marks analysis has the

ability to defend the innocent, protect children from harmful care givers and convict the guilty, this at the same time, may also be the enemy of natural justice.

Conclusion

Identification of culprit in heinous crime is a challenging task with diversity in crime scenario these days. Use of bite marks with their few short coming have become an important tool in investigation.

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